Appendix 5-1

Geomechanics Laboratory Report

1. OBJECTIVE

The purpose of this investigation was to determine the uniaxial compressive strength and elastic modulus of coal from the Genwal mine, Huntington, Utah. The work is part of the preliminary studies for developing a basic computer model of the mine ground The test results were used as part of the data input for the rheological analysis (using SGI's proprietary computer code REM) and will be utilized later in supporting the interpretation of the measurement of in situ stress states.

2. SAMPLE SPECIFICATIONS

Coal blocks obtained from the mine were cut to produce rectangular samples (Fig. A-1). The sample dimensions vary from 2.5x2.5x4.0 in. to 3.0x3.0x5.0 in. The sample densities were calculated from the weight and dimensions. Table 1 summarizes the sample dimensions and densities. Perpendicularity and parallelism of the samples, particularly between the loading surfaces, were maintained to less than 1^{o} deviation. Prior to testing, all samples were left air-dried for at least 24 hrs. The preparation was made such that the loading direction was normal to the bedding planes.

TABLE 1. Coal Sample Specifications

Sample No.	Dimensions (in.)	Weight (lbs)	Density lb/ft^3 (g/cc)
C1-1-2-UN1	2.47x2.79x4.27	1.38	81.0 (1.30)
C3a-1-2-UN2	2.67x3.04x4.30	1.69	83.7 (1.34)
C7-1-3-UN3	2.98x3.13x4.98	2.19	81.5 (1.31)
		Average	82.1 (1.32)

Two major sets of pre-existing cracks were observed in the coal blocks. The sets of cracks were perpendicular to the bedding planes and at an angle

of about 45° to each other. The crack spacing was about 6 in. The test samples were prepared as much as possible to avoid these cracks.

3. TEST METHOD

The coal samples were loaded uniaxially to failure, using a Forney testing machine (model FT-21). The load on the sample was calculated from oil pressure injected into the loading ram by means of a hydraulic hand pump. The pressure was measured to the nearest 10 psi, which was equivalent to a 280-lb load on the ram. The vertical (axial) deformation of the sample was monitored using a displacement dial gauge (±0.001-in. accuracy). The sample was loaded at an approximate rate of 500 lbs/min. Teflon sheets were placed between the loading plates and sample end surfaces to reduce the friction at the interfaces (Fig. A-2).

The failure load was recorded and the fracture patterns mapped. The uniaxial compressive strength and Young's modulus was evaluated from the load-displacement curves.

4. TEST RESULTS

Table 2 summarizes the results from coal testing. The uniaxial compressive strength and Young's modulus average 1821 psi and 270 ksi, respectively. The strength was calculated assuming that the cross-sectional area of the sample remained unchanged during loading. The Young's modulus was measured from the tangent at 50% of the failure stress.

TABLE 2. Summary of Test Results

Sample No.	Uniaxial Compressive Strength psi (MPa)	Young's Modulus ksi (GPa)
C1-1-2-UN1	1308 (9.01)	153 (1.05)
C3a-1-2-UN2	1748 (12.29)	174 (1.20)
C7-1-3-UN3	2406 (16.58)	294 (2.03)
Average	1821 (12.55)	207 (1.43)

Vertical fractures were induced at the failure stress (Fig. A-3). This indicates lack of friction on the sample loading surfaces. Sample UN3 yielded higher compressive strength and Young's modulus than samples UN1 and UN2 before testing. This is attributed to the fact that sample UN3 was free of pre-existing cracks, while at least two cracks were observed on the surfaces of samples UN1 and UN2. Fig. A-4 illustrates the axial stress-strain curves of samples UN1, UN2, and UN3.

5. CONCLUSIONS

Uniaxial compression tests were performed on three rectangular samples of coal from Genwal mine, Utah. The average compressive strength and Young's modulus obtained were 1821 psi and 207 ksi. Wide ranges of strength and stiffness were observed among the samples due to the presence of pre-existing cracks. An intact coal sample provided strength and stiffness values of 2406 psi and 294 ksi, respectively (i.e., sample UN3).

These mechanical properties were used as part of the data input for rheological analyses of the mine ground and will be used later in support of the interpretation of *in situ* stress measurements.

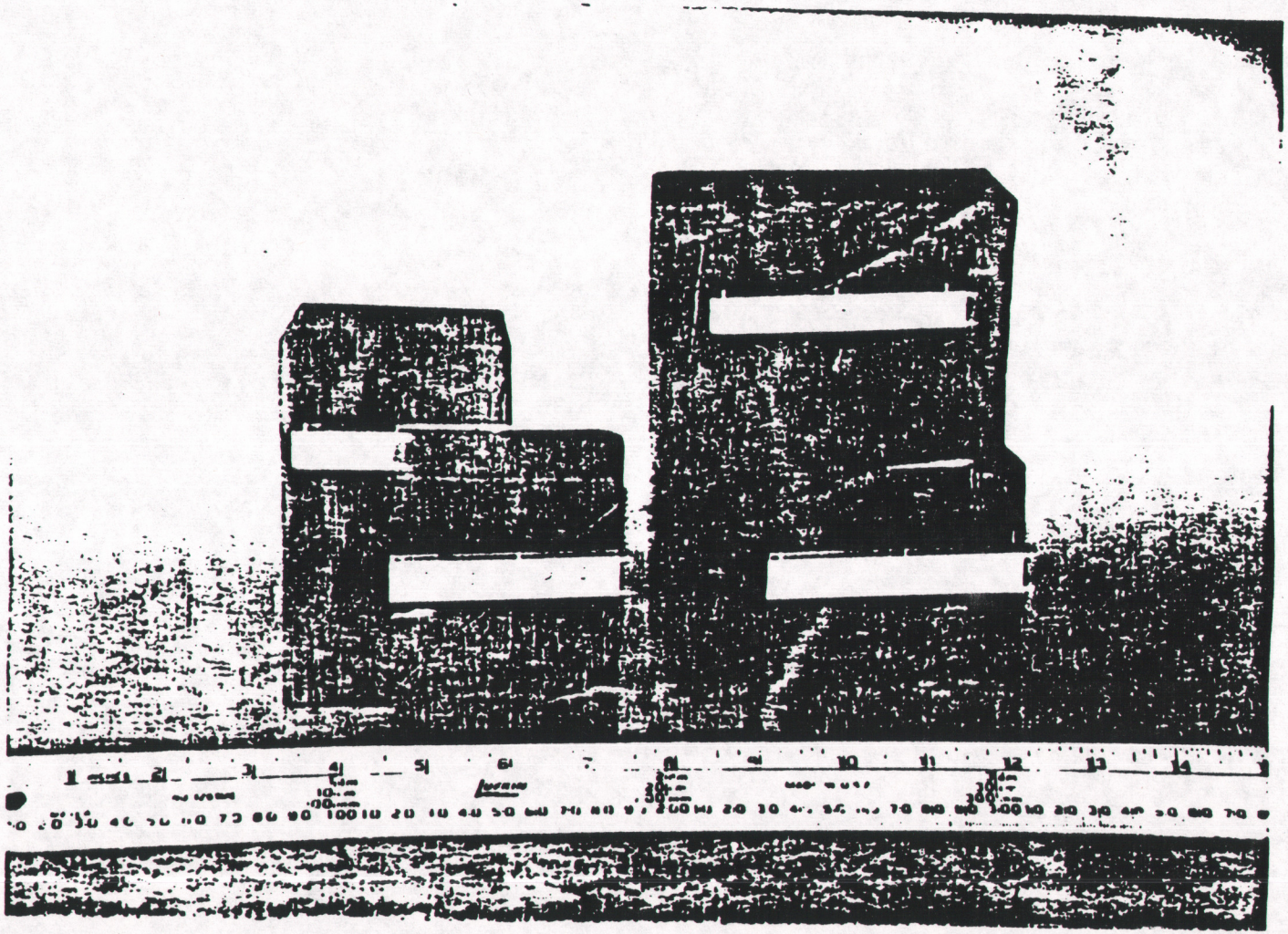

FIG. A-1. Rectangular block samples of coal, prepared for uniaxial compression test

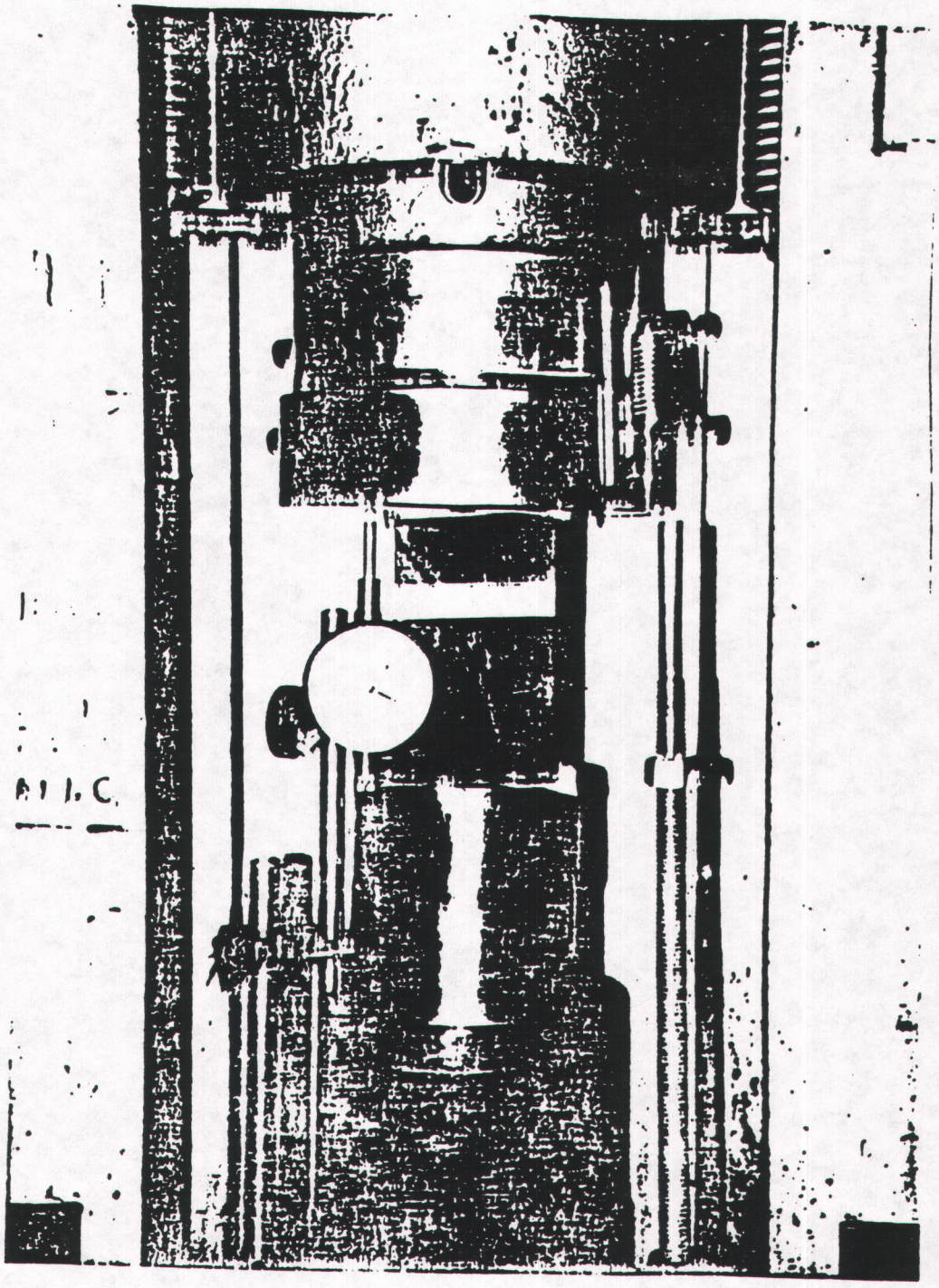

FIG. A-2. Coal sample placed on loading machine. Displacement dial gauge measures axial deformation. Teflon sheets placed between sample end surfaces and loading platen to reduce interface friction.

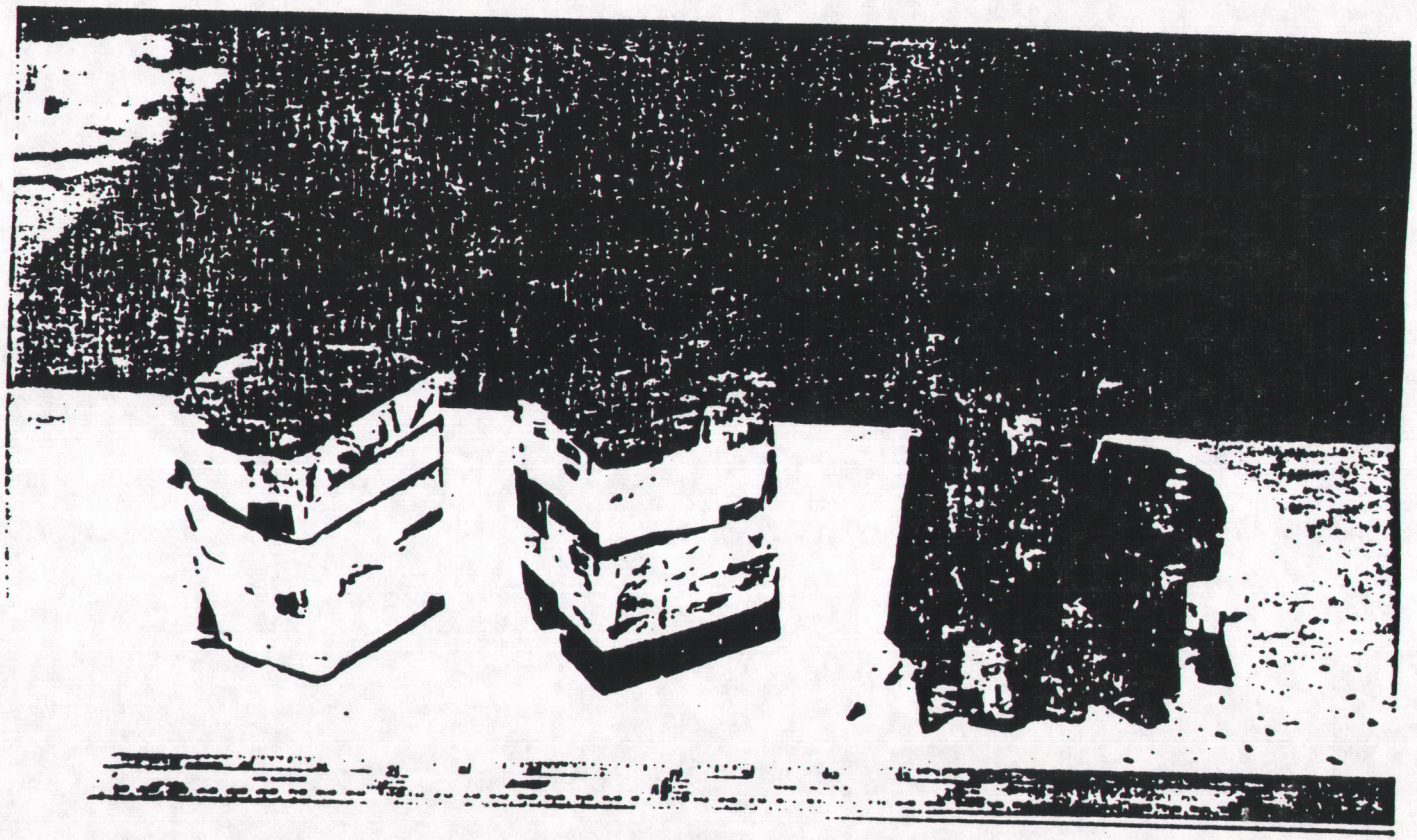

FIG. A-3. Post-test samples of coal showing vertical fractures induced by uniaxial loading

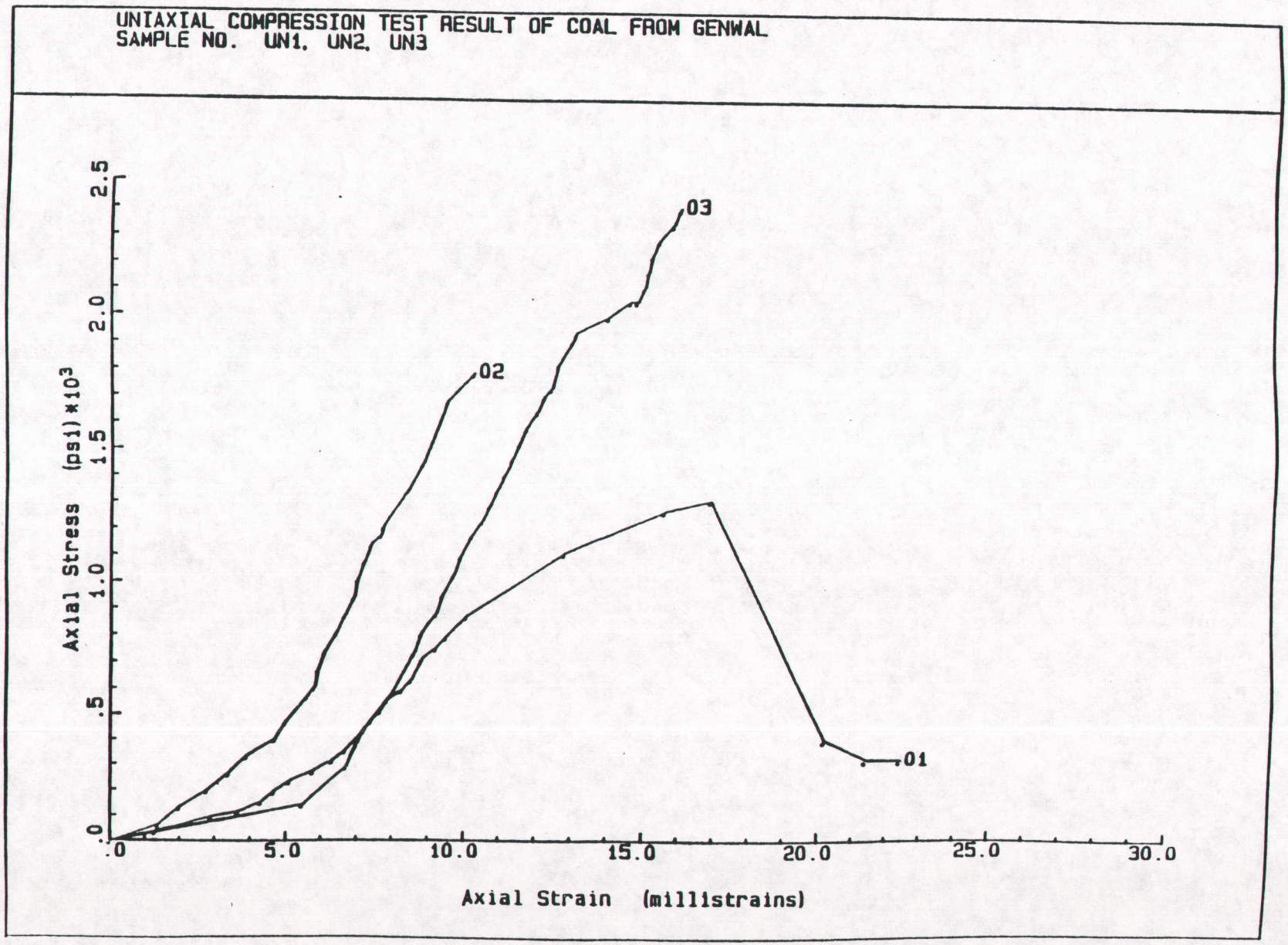

FIG. A-4. Uniaxial test results: Axial stress-strain curves from coal testing. Sample UN3 free of fractures gives highest strength.